

REMARKS

Applicants have amended claims 1-4, 7, 8, 10, 11, 13, 14, 17, and 19; and have added new claims 23-41. Support for the amendments can be found, for example, at page 8, lines 11-15, and Fig. 3A. The amendments to claim 1 clarify the term “state of charge” and move this term into the body of the claim. The amendments to dependent claims 2-4, 7, 8, 10, 11, 13, 14, 17, and 19 correct grammatical errors and do not narrow the scope of the claims. Claims 1-41, of which claims 1, 23, 27 and 31 are independent in form, are presented for examination.

Prior to this Amendment, claims 1-7, 12, 13, 20 and 22 were rejected under 35 U.S.C. § 102(b) as anticipated by U.S. Patent No. 5,656,915 (“Eaves”); and claims 1, 18, 19 and 21 were rejected under 35 U.S.C. § 102(b) as anticipated by U.S. Published Patent Application No. 2002/0109482 (“Anzawa”).

As amended, claims 1-22 recite a system including a string of electrical energy storage units, and a power converter selectively coupled to an individual storage unit of the string of storage units. Among other things, the power converter is configured to balance state of charge of the individual storage unit to a target state of charge, the state of charge of the individual storage unit being a fraction of a fully charged capacity of the individual storage unit.

Neither Eaves nor Anzawa discloses or suggests anything that balances state of charge as recited in the amended claims, let alone a power converter selectively coupled to an individual storage unit of a string of storage units and configured to balance state of charge. At best, these references describe equalization of cell voltage (see, e.g., Eaves col. 7, lines 2-38). In response to the Examiner’s indication that “[s]tate of charge is directly related to the voltage level of a cell, especially when compared to its maximum possible voltage level” (see Office Action pp. 7-8), this point is moot in light of the amendments to claims 1-22. Balancing state of charge, as clarified in the amended claims, is not the same as balancing cell voltage.

As Applicants explained in the specification, balancing state of charge, as that term is used by Applicants, is different from balancing cell voltage and can enhance battery life and safety:

In prior art techniques, charge is measured and used as an indicator of cell equalization. However, charge, which is measured in Ampere-hour (Ah), is quite different from state of charge (SOC). It is not sufficient to only measure charge in

order to equalize cells, because cells having the same charge may not have the same state of charge.

For example, assume two cells have a capacity of 20 Ah. When the cells are charged to 20 Ah, both have a 4.2V potential. Assuming that full cell capacity can be utilized, the cells can be equalized to a state of charge of 50% by equalizing the charge of the cells to 10 Ah, resulting in a certain voltage less than 4.2V.

However, assume further that the two cells degrade differently, such that the first cell can only achieve a maximum capacity of 18 Ah and the second cell can only achieve a maximum capacity of 15 Ah in their respective degraded state. When both cells are charged to their maximum capacities, both have a voltage potential of 4.2V. In this case, if the two cells are equalized to an equilibrium charge of 10 Ah, the first cell would be discharged by 8 Ah and the second cell would be discharged by 5 Ah. This results in the cells having different states of charge (i.e., 56% and 67% respectively), and thus two quite different cell voltages. Hence the cells are not considered equalized.

Therefore, the method of equalizing cell charge does not become reliable for the degraded cells or for cells that are not equivalent in nature. This inability to equalize state of charge leads to low battery life and safety hazards. The low life is caused by potential deep discharge or overcharging, resulting from the inability to determine state of charge. Further, and especially for lithium-ion batteries, the overcharge or over-discharge may cause thermal runaway due to possible formation of dendrites that can cause internal shortage of the cells.

(See page 8, line 26 to page 9, line 21 of the specification.)

In light of the above amendments and remarks, and without conceding that the cited references disclose or suggest any other features of the presented claims, Applicants request that the rejections of claims 1-7, 12, 13, and 18-22 over Eaves and Anzawa be withdrawn.

New claims 23-30 correspond to previously-presented claims 8-11 and 14-17, which the Examiner has indicated as allowable if rewritten in proper form. Applicants have written claims 23-30 without the “for balancing state of charge among plural series connected electrical energy storage units” language in the preamble, which is consistent with the Examiner apparently not giving the preamble any patentable weight (Office Action p. 8). New claims 23-30 should be passed to allowance.

New claims 31-41 are patentable over the cited reference for at least the reason that the cited references do not disclose or suggest a system including a string of electrical energy storage units, and a power converter coupled to a selected portion of the string of electrical energy storage units *and* to end points of the string of electrical energy storage units. For example, Eaves describes a system having switching circuitry 2 that can access individual cells 4a-4d by tap points 5a-5e. Eaves describes a system that can couple to a selected portion of the string of cells *or* to end points of the string of cells, but Eaves does not describe a power converter coupled to a selected portion of the string of electrical energy storage units *and* to end points of the string of electrical energy storage units, as claimed. Anzawa does not describe coupling to a selected portion of a string of cells; instead the cells are all simultaneously coupled to the string and charge is distributed from the string to individual cells according to their terminal voltages. Like Eaves, Anzawa does not describe a power converter coupled to a selected portion of the string of electrical energy storage units *and* to end points of the string of electrical energy storage units, as claimed. Therefore, for at least these reasons, new claims 31-41 are patentable over the cited Eaves and Anzawa.

Conclusion

For at least the reasons discussed above, Applicants believe the claims are in condition for allowance, which action is requested. If allowance of this matter can be expedited, Applicants invite the Examiner to call the undersigned representative.

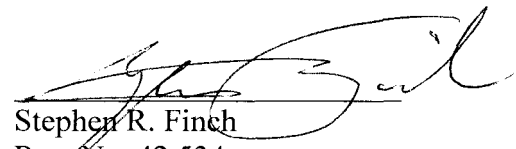
Please apply any other charges or credits to deposit account 50-3421 (referencing Attorney Docket No. TI01.702US).

Respectfully Submitted,

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By their Representatives,
FINCH & NGUYEN PLLC

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